

garded as rather exaggerated compression, we may quote a sentence that disposes of the performance of the Campbell-Stokes sunshine recorder, in common use in this country :—

"A sheet of pasteboard or a block of wood at the rear receives the record, and the extent of the charring gives a crude measure of the percentage of full or strong sunshine."

Without further details one cannot help feeling that if the crudeness were entirely in the record, it would never have attached to it the name of the great philosopher about whose work the word "fastidious" seems, if anything, more appropriate than "crude." Again, the system of photographic recording adopted in this country for the barometer and thermometer is dismissed in an equally curt manner as not being "quite adequate to present needs"; it is difficult to see how the "needs" have changed since 1867, when the aspirations of meteorologists were described in words which might be adopted without change to-day.

A similar brevity runs through the whole article. Take, for example, an account of cirrus clouds :—

"They may be formed by mixture or even sometimes by mere contact and the conduction of their own heat to neighbouring cold air. More frequently they must be due to cooling of moist streaks in the atmosphere by expansion and radiation."

If one only really knew whether this is true or not, what should we not know about meteorology? It may be remarked, by the way, that in dealing with the thermal expansion of gases, there is a superfluity of zeros which would alter the whole face of nature if they could not be satisfactorily accounted for by the usual vagaries of the printer.

The article may be described without much exaggeration as a view of the present state of meteorology as seen from Washington. It is a great advantage to have a compendious view of so wide a subject from that most active centre, and from so competent a pen as Prof. Abbé's. No one need complain because the treatment is necessarily somewhat eclectic.

The section on climatology is devoted mainly to rainfall and the generalisations based on rainfall data from all parts of the world. The section on physical and theoretical meteorology is an especially valuable summary, including the most modern developments of the application of dynamical, thermodynamical and electrical theory. The final section, on meteorological organisations, leads, as all such considerations must lead, to the expression of the need for meteorological laboratories in important universities, following in this respect the analogy of the sister science of astronomy.

The reader with scientific tastes is not recommended to follow the reviewer in a rapid survey of the subjects of scientific interest in this volume. If he does so, he can hardly fail to be reminded of those public occasions on which it is felt necessary to give to as many distinguished persons as possible an opportunity, however short, of saying a few words. When the ingenuous reader feels a little at a loss to know why a particular title is selected as the subject of an article in an encyclo-

pædia, the initials at the end may be relied upon to suggest a sufficient reason.

The tendency to represent authors is, perhaps, more conspicuous in this volume than in the ninth edition. An inquisitive person might even find himself wondering whether the term Britannica does not require some adjustment.

THE GEOLOGY OF CENTRAL BORNEO.

Geological Explorations in Central Borneo (1893-94). By Dr. G. A. F. Molengraaff. English Revised Edition, with an Appendix on Fossil Radiolaria of Central Borneo by Dr. G. J. Hinde. Pp. xx+530 + 56; with 89 illustrations in the text, 56 plates, 3 maps, and a folio atlas of 22 geological maps. (Leyden: E. J. Brill; Amsterdam: H. Gerlings; Sold in London by Kegan Paul, Trench, Trübner and Co., Ltd., 1902.) Price 2*l.* 12*s.* 6*d.* net.

THE Dutch edition of this work appeared in 1899, and Dr. Hinde's appendix, then issued in English, is now transferred, with its separate pagination, to the translation of the complete work. The Borneo Expedition, of which Dr. Molengraaff was the geological member, was organised by Mr. S. W. Tromp, Resident of West Borneo, in connection with the Society for the Promotion of the Scientific Exploration of the Dutch Colonies. The observations were made some ten years ago, and the author has not included references to the work of others, published since the completion of the Dutch edition. We are in possession, however, of the summary of the geology of Borneo drawn up by Dr. E. Suess in 1901 ("Das Antlitz der Erde," 3ter. Band, pp. 308-319), and many readers have already turned to that summary for an exposition of the work of Molengraaff. Dr. Posewitz, about 1890, brought together, after three years' residence in the island, the facts then known about the geology and mineralogy of Borneo ("Borneo"; translated by Hatch, 1892), and his geological sketch-map was intended to show how large a part of the country had already been examined in a preliminary kind of way. Dr. Molengraaff, in his atlas, provides only one geological map, dealing with the parts of Central and South Borneo known to him; an enlarged map of a portion of this area follows, and the other maps prudently record the observations actually made on the banks of the rivers, which provide practically the only routes for travellers in the country. Some generalised sections and panoramic landscapes follow, the latter proving that wide views are obtainable when observers climb above the forest-zone. The fine illustrations and plates in the volume of text reveal, moreover, many features of crag and mountain that will be new to those who think of Borneo as clothed with vegetation, amid which the rivers wander in equatorial shade.

The province of West Borneo, with which the author mainly deals, is practically the basin of the Kapoewas (the River Kapuas of Posewitz). By following it eastward, across a wooded region, where the projections of antique Borneo rise like islands above the vast alluvium, the traveller reaches Sintang, 2600 km. in a straight line from the coast. Here Dr. Molengraaff's

serious work began. He starts at once (p. 19) with the interesting observation that the coarse auriferous gravels near Sintang show that the carrying power of the rivers was formerly greater; and the explanation is found in the greater height of the ranges of the interior in late Cainozoic times. The author returns to these deposits in his valuable geological summary (pp. 453-9), where he states his conclusion that Borneo has undergone continuous degradation, through atmospheric action, in the Quaternary era. The products of decay have encroached on what was in earlier times a shallow sea, broadening the land, and connecting island after island with the central mass by new deposits of alluvium. At the same time, the alluvium has accumulated on the decaying ranges, burying their lower slopes in material which they themselves supplied. In opposition to the elevation-theory of Posewitz, Molengraaff sees in the growth of the river-deposits the real cause of the post-Pliocene extension of Borneo.

From Sēmitau, higher up the Kapoewas, the author diverged through the thick forest, up a side-stream to Mount Kēnepai. This is a steep mass 1136 m. above the sea, carved out of granite injected by andesite, the granite (p. 432) being of post-Jurassic age. Still more interesting igneous features are seen in the next range visited, on the Mandai River, where huge horizontal beds of volcanic tuff give rise to "table-mountains" bounded by vertical rock-walls. Molengraaff (p. 65) names this range the Müller Mountains, after the murdered explorer Georg Müller, who is believed to have penetrated the area. The volcanic action that here poured out rhyolite and andesite and abundant tuffs along an east-and-west line in Central Borneo was probably post-Cretaceous (p. 441), and may have continued throughout Cainozoic times. The range is now known to extend over at least 280 km., and has doubtless (p. 445) an important relation to the post-Cretaceous movements of the land. Have we here, indeed, unexpectedly revealed by Molengraaff, one of those volcanic chains that accompany the Eurasian "Alpine" system of folding? The author shows how the Müller Mountains have been piled on sunken land (p. 445), which has been lowered by east-and-west faults from the south flank of the Upper Kapoewas range. This old range, the slates of which are possibly of Palaeozoic age, was at one time covered by Jurassic rocks, the age of the latter being determined by Dr. Hinde's observations on the radiolaria. These rocks, now preserved by the downward faulting in the lake-district north of Sēmitau (pp. 123 and 414), are grouped by Molengraaff as the "Danau formation." The faulting has affected the "Eogene" sandstone strata, which once spread across the folded Cretaceous and Danau systems, and terminated somewhere on the flanks of the Upper Kapoewas chain. The plain of the Upper Kapoewas River was thus determined by the downthrow of the Danau beds in Middle Cainozoic times, whereby the chain of mountains to the north was more than ever emphasised. While intrusions of granite had already (p. 449) accompanied the post-Jurassic and pre-Eocene movements, the volcanic line of the Müller Mountains made its appearance along one of the Middle Cainozoic faults.

In the eyes of Suess ("Antlitz," Bd. iii., pp. 312, 315, and Tafel xi.), the Upper Kapoewas range forms part of a great bow extending southward from the Philippines, and the volcanoes have arisen on the faulted outer side.

The association of radiolarian cherts with diabase and diabase-tuff, as described so often by the author, seems almost inevitable, although the beds in Borneo are of Jurassic or early Cretaceous age. Mr. J. J. H. Teall has discussed this phenomenon; and it seems independent of geological age. One is reminded of Anglesey, where Mr. Greenly (*Quart. Journ. Geol. Soc.*, 1902, p. 433) has been led to consider the cherts as of organic origin, on account of their association with "pillowy diabase"—so firmly has the connection of these two types of rock, however improbable at first sight, become established in recent years as an article of geological belief.

We must merely mention the interesting ascent of Mount Kēlam, a strangely smooth boss of pre-Cretaceous microgranitic rock, the surface of which (p. 138) peels off like the layers of an onion, as in the instances studied by Branner in Brazil. It soon becomes clear to the reader that Central Borneo is rich in a variety of mountain-forms. While Dr. Molengraaff's landscapes will interest the geographer and the artist, other illustrations are of ethnographical value. The chapter on river-curves (p. 473) introduces a new term, "pintas," the Dyak name for a natural short-cut formed across the loop of a meandering stream. Unfortunately it has no convenient European plural, or it might be of much service in geography.

Dr. Hinde's important appendix is already known to palaeontologists. The English in the translated part of the volume is, as a whole, clear and carefully printed. The two misprints in the title of plate lii. should, however, have been avoided, but are more than balanced by the action of the English binders, who have curtailed the author's name on the exterior of both the volumes. Dr. Molengraaff has added so much to our knowledge of a difficult country, especially in regard to its tectonic history, that we trust that political disturbances have not removed him permanently from another field of observation, where his work was only just begun.

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PROCEEDINGS OF THE GERMAN ZOOLOGICAL SOCIETY.

Verhandlungen der deutschen zoologischen Gesellschaft. xii. Versammlung, Giessen, 1902. Pp. iv + 221. (Leipzig: Engelmann, 1902.)

THE German Zoological Society consists of about 240 experts, who meet in variable numbers for two or three days annually in some happily chosen hospitable spot, where they hold high discourse. There were only about sixty members present at last summer's (twelfth) meeting in Giessen, but the Society, if not large in numbers, is strong in quality. It is not pecuniarily rich, for it has backed out of more than an honorary responsibility with regard to one of its offspring—an expensive child—"Das Tierreich," which the Berlin Academy of Science will henceforth solely foster, but it is rich in enthusiasm, as we infer